





New records of *Lophostoma brasiliense* Peters, 1867 (Chiroptera, Phyllostomidae) from São Paulo and Mato Grosso do Sul, Brazil

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Abstract

We report on new occurrence records of *Lophostoma brasiliense* Peters, 1867 (Chiroptera, Phyllostomidae) from the states of São Paulo and Mato Grosso do Sul, southeastern Brazil. Specimens from São Paulo were mist-netted in an area originally covered by the Atlantic Forest and Cerrado ecosystems of which only small and isolated fragments remain, while the specimens from Mato Grosso do Sul came from a well-preserved Cerrado area. The new records confirm the presence of *L. brasiliense* in the Brazilian state of São Paulo and clarify the southern edge of the species' range.

Keywords

Atlantic Forest, Cerrado, fragmented landscape, highway underpasses, Pygmy Round-eared Bat

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Introduction

The Pygmy Round-eared Bat, *Lophostoma brasiliense* Peters, 1867 (Phyllostomidae, Phyllostominae), is distributed from southern Mexico to central Paraguay and southeastern Brazil (Hall 1981; Williams and Genoways 2008). Throughout its range it inhabits primary and secondary evergreen and deciduous forests, where it uses active termite nests as day roosts (Goodwin and

Greenhall 1961; Handley 1966, 1976; Carmignotto et al. 2012). Although *L. brasiliense* may be commonly captured in areas central to its distribution, such as the Amazon (Handley 1976; Simmons and Voss 1998; Tavares et al. 2017), only a few specimens are known from the southern limits of its range (López-González et al. 1998; Mangolin et al. 2007).

Along the southern part of the distribution of *L. brasiliense*, there are records from Paraguay (López-González et al. 1998) and the Brazilian states of Rio de Janeiro (Ávila-Pires and Gouvêa 1977), Mato Grosso do Sul (Bordignon 2006; Fischer et al. 2015), and Minas Gerais (Tavares et al. 2010). Although *L. brasiliense* has not been recorded in the state of São Paulo, its presence is expected as there are near records in the adjacent states of Rio de Janeiro, Minas Gerais, and Mato Grosso do Sul (Vivo et al. 2011; Garbino 2016).

In this report, we present new records of *L. brasiliense* for the Brazilian states of São Paulo and Mato Grosso do Sul. Our data fill a distribution gap and clarify the southern limits of the distribution of the species.

Methods

Study area. The specimens reported here were collected in areas originally covered by forested habitats of the Atlantic Forest (localities 4 and 8 in Fig. 1) and Cerrado (locality 5 in Fig. 1) ecosystems. However, these areas are currently dominated by pasture and sugarcane plantations and most of the native forest remnants are small (<100 ha) and isolated (Ribeiro et al. 2009; Rezende 2014). Climate in the area corresponds to Aw in

the Köppen classification, with a rainy season during the summer (September to March) and a dry season in the winter (April to August) (Rocha and Tommaselli 2012; Homem et al. 2020).

Data collection. Our new records are based on four specimens mist netted by us between 2012 and 2020 in São Paulo state, and two museum specimens from Mato Grosso do Sul state collected in 1992. Analyzed specimens are deposited in the collections of the Escola Superior de Agricultura Luiz de Queiroz (LMUSP), Piracicaba; Museu de Zoologia da Universidade de São Paulo (MZUSP), São Paulo; and Universidade Federal de Mato Grosso do Sul (ZUFMS), Campo Grande.

The specimen from Caiuá (LMUSP 512), São Paulo state, was mist netted near the entrance of a culvert passing under highway SP-270. On 11 October 2020, one mist net was set at each of the two openings of the culvert and both were kept open from 18:00 to 23:00. The fieldwork that resulted in its capture was part of a study assessing the use of highway underpasses by bats, structures known to be used by several non-volant mammals in the neotropics (Abra et al. 2020). Three individuals were mist netted in different localities in the Reserva Particular do Patrimônio Natural (RPPN) Foz do Aguapeí, a privately owned protected area of 14,000 ha in western São Paulo state.

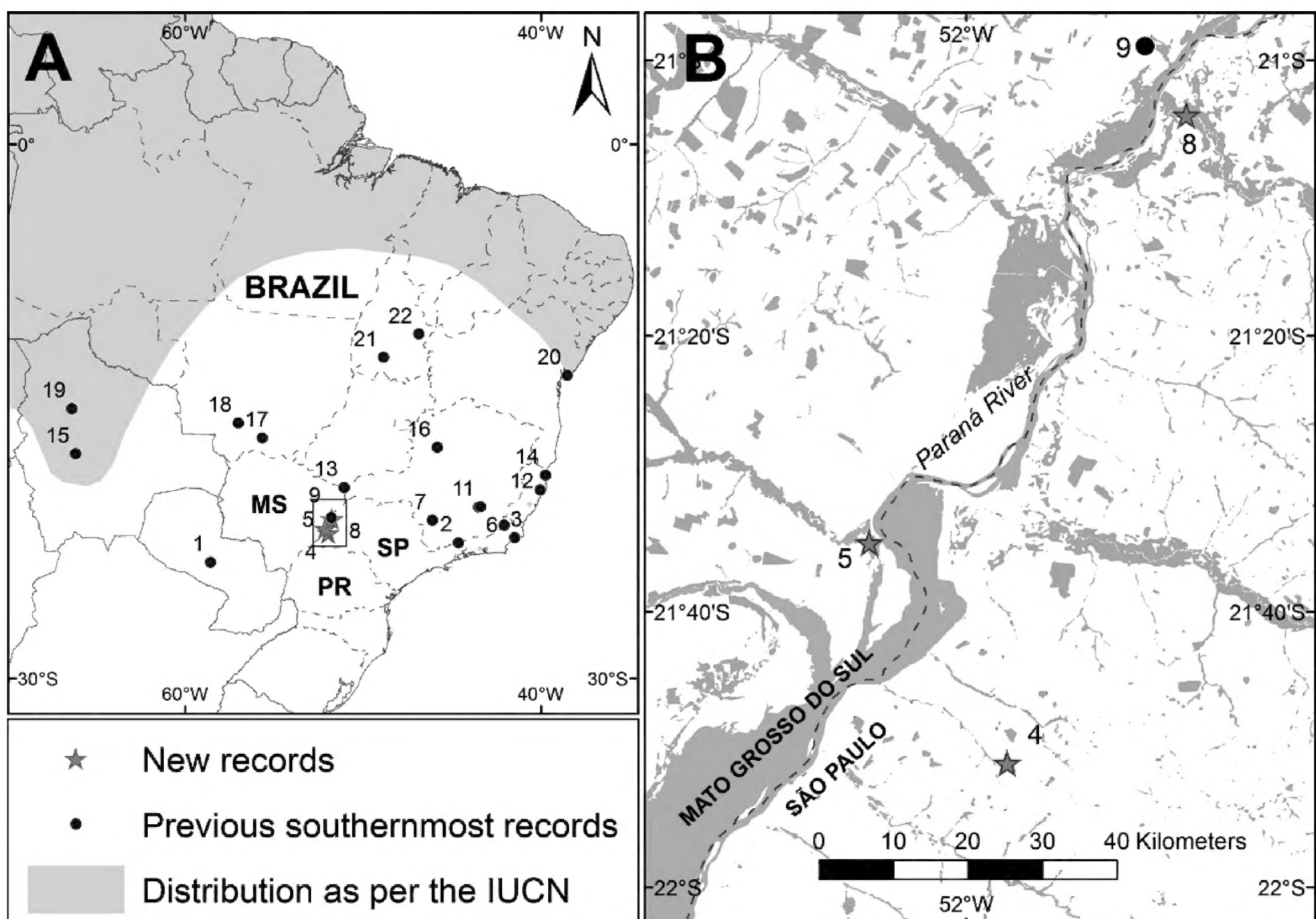


Figure 1. A. Southern part of the distribution of *Lophostoma brasiliense*, showing the southernmost known records (dots), the new records (stars) presented herein, and part of the International Union for Conservation of Nature (IUCN) polygon for the taxon (Sampaio et al. 2016). MS = Mato Grosso do Sul state, PR = Paran  state, SP = S o Paulo state. **B.** Detail of the area where the new records of *L. brasiliense* were made. The Paran  River is in light blue and the native vegetation remnants are in light green. Numbers correspond to the localities in Table 1.

Table 1. Southernmost localities of *Lophostoma brasiliense*. The “Locality number” field correspond to localities in Figure 1.

Locality no.	Locality	State/department	Country	Coordinates	Source
1	Estancia La Victoria	Presidente Hayes	Paraguay	23°29'S, 058°34'W	López-González et al. 1998
2	Parque Nacional do Itatiaia	Rio de Janeiro	Brazil	22°23'S, 044°38'W	Ávila-Pires and Gouvêa 1977
3	Restinga de Jurubatiba, Quissamã	Rio de Janeiro	Brazil	22°06.24'S, 041°28.20'W	Mangolin et al. 2007
4	SP-270 highway, Caiuá	São Paulo	Brazil	21°51'34.18"S, 051°57'54.69"W	This study
5	Fazenda Barma, Brasilândia	Mato Grosso do Sul	Brazil	21°35'S, 052°07'W	This study
6	Paraíso do Tobias, Miracema	Rio de Janeiro	Brazil	21°24'16.26"S, 042°04'03.66"W	Mangolin et al. 2007
7	Poços de Caldas	Minas Gerais	Brazil	21°08'S, 046°06'W	Tavares et al. 2010
8	RPPN Foz do Aguapeí	São Paulo	Brazil	21°04'S, 051°44'W	This study
9	Fazenda Barra do Moeda, Três Lagoas	Mato Grosso do Sul	Brazil	20°59'S, 051°47'W	Homem et al. 2020
10	Ouro Preto	Minas Gerais	Brazil	20°23'S, 043°30'W	Tavares et al. 2010
11	Mariana	Minas Gerais	Brazil	20°22'S, 043°24'W	Tavares et al. 2010
12	Linhares	Espírito Santo	Brazil	19°25'S, 040°03'W	Peracchi and Albuquerque 1993
13	Fazenda Lagoinha, Fazenda Vale do Sol, Inocência	Mato Grosso do Sul	Brazil	19°17'03"S, 051°03'06"W	Bordignon 2006
14	Conceição da Barra	Espírito Santo	Brazil	18°35'S, 039°45'W	Ruschi 1953
15	Sajta	Cochabamba	Bolivia	17°24'S, 066°09'W	Anderson 1997
16	Fazenda Brejão, Brasilândia de Minas	Minas Gerais	Brazil	17°02'S, 045°50'W	Tavares et al. 2010
17	RPPN Sesc Pantanal	Mato Grosso	Brazil	16°30'S, 055°40'W	Escarlate-Tavares and Pessoa 2005
18	Estação Ecológica da Serra das Araras	Mato Grosso	Brazil	15°39'S, 057°01'W	Gonçalves and Gregorin 2004
19	Estación Biológica Beni	Beni	Bolivia	14°51'S, 066°21'W	Anderson 1997
20	Salvador	Bahia	Brazil	12°59'S, 038°31'W	Peters 1867
21	Sucupira	Tocantins	Brazil	11°58'S, 048°50'W	Nunes et al. 2005
22	Estação Ecológica da Serra Geral	Tocantins	Brazil	10°40'S, 046°52'W	Gregorin et al. 2011

Sampling in this area took place in 10 field expeditions between January 2011 and December 2012, using 10–12 mist nets which were kept open from 18:00 to 00:00. The final sampling effort was 68,982 m²·h, following Straube and Bianconi (2006). Of the three captured individuals, two were collected (ZUFMS 2212, 2213) and an adult female was released. We also revised and included two specimens from Fazenda Barma, in Brasilândia, Mato Grosso do Sul state, that were collected in 1992 (MZUSP 28625, 28626). Permits to handle and collect the specimens from RPPN Foz do Aguapeí and Caiuá were provided by the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Ministry of the Environment (processes no. 31568 and 75467, respectively).

At both Caiuá and RPPN Foz do Aguapeí, specimens had their forearms measured and were weighed in the field. We took measurements of forearm and skull with digital calipers to the nearest 0.01 mm, using selected dimensions based on Velazco and Cadenillas (2011), as follows: forearm length; greatest length of skull; post orbital breadth; zygomatic breadth; braincase breadth; distance across upper canines; maxillary toothrow length; mandibular toothrow length, and dentary length.

To describe and assess the southern edge of the distribution of *L. brasiliense*, we compiled all previous southernmost records of the species, considering localities south of the 10°S parallel (Table 1), and compared with the distribution shown in the IUCN assessment of *L. brasiliense* (Sampaio et al. 2016).

Results

New records. BRAZIL – **Mato Grosso do Sul** • Brasilândia, Fazenda Barma; 21°35'S, 052°07'W; alt. ca.

300 m above sea level; 18.XI.1992; J.L.Silva Filho leg.; 1 adult ♂, taxidermied skin with separated skull, MZUSP 28625 • Brasilândia, Fazenda Barma; 21°35'S, 052°07'W, ca. 300 m a.s.l.; 18.XI.1992; J.L.Silva Filho leg.; 1 adult ♀, taxidermied skin with separated skull, MZUSP 28626 – **São Paulo** • Castilho, RPPN Foz do Aguapeí; 21°05'14"S, 051°41'55"W; alt. 263 m a.s.l.; 13.III.2012; A.L.A. Lima leg.; 1 adult ♂, specimen in alcohol, ZUFMS 2212 • Paulicéia, RPPN Foz do Aguapeí; 21°09'00.5"S, 051°48'12.4"W; alt. 259 m a.s.l.; 14.III.2012; A.L.A. Lima leg.; 1 adult ♀, specimen in alcohol, ZUFMS 2213 • RPPN Foz do Aguapeí; 21°07'06"S, 051°45'44"W; alt. 265 m a.s.l.; 11.IV.2012 A.L.A. Lima obs.; 1 adult ♀, individual was released (Fig. 2A) • Caiuá, km 632 of SP-270 highway; 21°51'34"S, 051°57'54"W; alt. ca. 320 m a.s.l.; 11.X.2020; G.S.T. Garbino, V.J.A. Pereira leg.; 1 adult ♂, taxidermied skin with separated skull and partial skeleton (Fig. 2B), GTG74; LMUSP 512.

Identification. *Lophostoma brasiliense* is the smallest species of the genus, with a forearm length of 34–40.5 mm and greatest length of skull of 18.7–21.6 mm (Williams and Genoways 2008; Solari et al. 2019). Dorsal hairs are bicolored, with a large pale buff base (approximately ¾ of the hair length) and dark brown tip. The venter is brown, of a slightly paler tone than the dorsum, and does not contrast with it. Ears are long and round.

The examined specimens had the diagnostic characters of *L. brasiliense*, such as brown dorsal and ventral pelage, long round ears (Fig. 2), one pair of lower incisors, and a visible sagittal crest (Fig. 3). Forearm and cranial measures were also within the variation range known for the taxon (Table 2). The released animal from RPPN Foz do Aguapeí had a 40 mm long forearm.



Figure 2. *Lophostoma brasiliense* **A.** Adult female (individual was released) from RPPN Foz do Aguapeí (São Paulo, Brazil); **B.** Adult male (LMUSP 512) from Caiuá (São Paulo, Brazil) showing the “ear curling” behavior typical of the genus.



Figure 3. Dorsal, ventral, and lateral views of skull and lateral view of mandible of *Lophostoma brasiliense* (LMUSP 512) from Caiuá, São Paulo, Brazil. Scale bar = 10 mm.

Lophostoma brasiliense may be confused with big-eared bats (genus *Micronycteris* Gray, 1866), from which it can be distinguished by having two lower incisors (four in *Micronycteris*), a well-developed sagittal crest, round warts on the chin (V-shaped pads in *Micronycteris*), free ears (ears connected by a band of skin in *Micronycteris*), and a more robust external appearance (Albuja 1999; York et al. 2019). Species of *Lophostoma* may be externally similar to species of *Tonatia* Gray, 1827, and some large members of the former genus may show overlap in forearm length with species of *Tonatia*. However, *L. brasiliense* is much smaller than known species of *Tonatia*, which have a forearm measuring between 51 and 62 mm (Williams and Genoways, 2008). Behaviorally, species of *Lophostoma* show a typical “ear curling” behavior (Fig. 2) which is absent in species of both *Tonatia* and *Micronycteris* (Williams and Genoways 2008).

Remarks

In the RPPN Foz do Aguapeí, 11 other bat species were captured: *Artibeus lituratus* (Olfers, 1818); *Artibeus planirostris* (Spix, 1823); *Carollia perspicillata* (Linnaeus, 1758); *Chiroderma doriae* Thomas, 1891; *Desmodus rotundus* (Geoffroy, 1810); *Glossophaga soricina* (Pallas, 1766); *Phyllostomus discolor* Wagner, 1843; *Phyllostomus hastatus* (Pallas, 1767); *Platyrrhinus incarum* (Thomas, 1912); *Platyrrhinus lineatus* (Geoffroy, 1810); and *Sturnira lilium* (Geoffroy, 1810). In the SP-270 highway culvert in Caiuá we also sampled *Carollia perspicillata*; *Lasiurus ega* (Gervais, 1856); *Noctilio leporinus* (Linnaeus, 1758); *Platyrrhinus lineatus*; *Sturnira lilium*; and an unidentified species of *Myotis*.

Discussion

Our new records fill a distribution gap for *Lophostoma brasiliense* in South America, confirming the presence of the species in the Brazilian state of São Paulo

Table 2. Forearm length and standard cranial measurements (in mm) of *Lophostoma brasiliense* from São Paulo and Mato Grosso do Sul, southeastern Brazil. Data from Velazco and Cadenillas (2011) are the mean and range of measurements of 78 specimens from Central and South America. GLS = greatest length of skull; PB = post orbital breadth; ZB = zygomatic breadth; BB = braincase breadth; C–C = distance across upper canines; MTRL = maxillary tooththrow length; MANDL = mandibular tooththrow length; DENL = dentary length.

Voucher	Locality	Sex	Forearm length	GLS	PB	ZB	BB	C–C	MTRL	MANDL	DENL
LMUSP 512	Caiuá	M	40	20.54	3.25	10.27	8.68	3.94	7.32	6.78	12.81
MZUSP 28625	Brasilândia	M	37.13 (broken)	18.14	3.58	broken	7.94	3.74	6.85	6.35	12.26
MZUSP 28626	Brasilândia	F	38.23	19.67	3.22	9.74	8.11	3.74	7.02	6.56	12.71
ZUFMS 2212	Castilho	M	40.5	–	–	–	–	–	–	–	–
ZUFMS 2213	Paulicéia	F	38.5	–	–	–	–	–	–	–	–
Velazco and Cadenillas 2011	Central and South America	M, F	35.2 (30.1–39.6)	20 (18.2–21.8)	3.2 (2.8–3.6)	9.5 (8.2–10.6)	8.1 (7.5–8.6)	–	–	7.7 (7–8.6)	12.6 (11.5–14)

and clarifying the southern limits of the species range (Table 1). The record from Caiuá (locality 4 in Fig. 1) lies approximately 97 km south of the closest known record (locality 9). To the west, the locality from Paraguay lies approximately 700 km from the new records (locality 1 in Fig. 1). To the east, the closest previously known record is from Poços de Caldas, Minas Gerais state, at approximately 600 km (locality 7 in Fig. 1). We also point out that the IUCN distribution map for the species needs to be updated, as there are several previous records of *L. brasiliense* that would alter the current polygon of the species, extending its range to the south (Ruschi 1953; Ávila-Pires and Gouvêa 1977).

The Atlantic Forest of western São Paulo state has been severely fragmented in the last decades (Ribeiro et al. 2009; Rezende 2014). Of the two locality records of *L. brasiliense* from the interior Atlantic Forest of São Paulo, one is from a privately owned protected area and other is from a highway culvert. We suggest that highway culverts help to improve permeability in this fragmented landscape. While it is known for other non-volant mammals that underpasses do increase habitat connectivity and reduce road-kill risk (Magioli et al. 2019; Abra et al. 2020), the use of such structures by bats is still poorly understood. We also note that *L. brasiliense* may occur in the larger protected areas near the RPPN Foz do Aguapeí: the Parque Estadual do Rio do Peixe and the Parque Estadual do Aguapeí. These two protected areas have each more than 6,000 ha and harbor several species of vertebrates that have become rare in the state (Faria and Pires 2010). Despite their importance, no bat inventories have been carried out in these protected areas.

Lophostoma brasiliense is conspicuously absent from the northwestern region of São Paulo, which was exhaustively sampled with mist nets and active search for diurnal roosts (Taddei 1973, 1975). Similarly, *L. brasiliense* has not been captured along the coast of São Paulo, an area intensively sampled for decades (Garbino 2016). The closest coastal record of the species comes from Restinga de Jurubatiba, Rio de Janeiro state, where capture rate of *L. brasiliense* was extremely low (Mangolin et al. 2007). The rarity of *L. brasiliense* in the southern localities, i.e., in Paraguay, and in the Brazilian states of São Paulo, and Rio de Janeiro, indicate that the southern range edge of the species lies around 23°S (Bahn et al. 2006).

With the new record, there are now 81 species of bats confirmed to occur in the state of São Paulo (Garbino 2016; Cláudio et al. 2020). The western region of São Paulo is one of the least known areas of the state in terms of mammal diversity, and new findings are still being made in the region (Garbino 2016; Prist et al. 2020). The fact that there are only a few protected areas and remaining fragments in western São Paulo should make this region a priority area in future assessments (Rezende 2014).

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Authors’ Contributions

GSTG collected the data and wrote an initial draft of the paper. PFCR and VF, collected the data and revised the manuscript. FDA and PRP provided field logistics and revised several versions of the manuscript. ALAL collected the data.

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